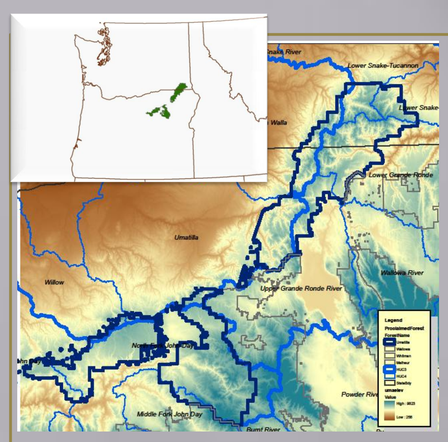
CLIMATE CHANGE AND WATERSHED VULNERABILITY

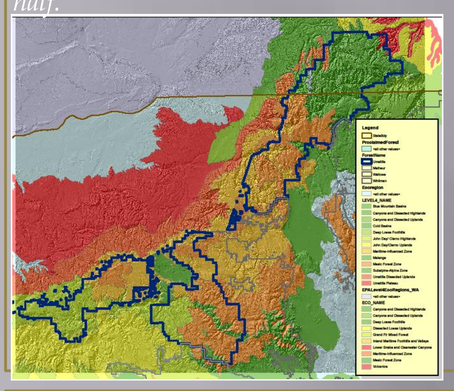
UMATILLA NATIONAL FOREST PILOT ASSESSMENT

Catherine Clifton, Kate Day and Allison Johnson,
Umatilla National Forest, Pendleton, OR

cclifton@fs.fed.us



Forest Context: 3 River Basins, elevations range from 2000 to 7000'. Complex mixed climate-geology systems, marine influence CRB north half, continental-mixed volcanics south half.

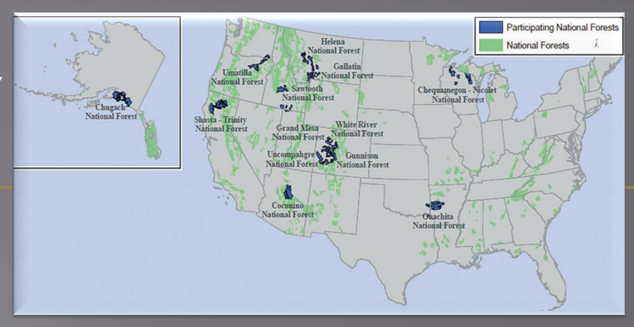


BACKGROUND

Intent is to display for managers the relative vulnerability of watersheds to climate change, identify watersheds containing water "values", or systems, that may be susceptible to changes in hydrologic conditions (Hurd et al, 1999, Furniss et al, 2010). Twelve Pilot Forest Case Studies underway.

On the Umatilla National Forest, we considered vulnerability at 2 scales :

1) Forest-wide at the HU6 scale (162 subwatersheds have UNF ownership from <1 to 100%) using categorical data and risk ratings, and,
2) Fine-scale analysis of 3 "Ecologicaly Significant Units" (ESUs) for Bull trout, a "hydrotherm" or highly temperature sensitive species, using a temperature model developed by the Rocky Mountain Research Station.



FOREST-SCALE ASSESSMENT FRAMEWORK

Values	Sensitivity	Exposure	Vulnerability	Response
Water Uses Infrastructure Aquatics	Base Watershed Condition ratings Resiliency factors Threats	Historic and Projected change (2030 and 2070) Winter Temp, Summer Temp, April 1 SWE	Relative rating based on values, sensitivity and exposure *Composite and individual value ratings*	Evaluate restoration priorities, infrastructure risk, opportunities for community engagement

Water Resource Values or Systems	Indicator or Sector	Historic or projected hydrologic changes	Impacts
Water Uses	Community water supply	Change in timing, water availability, increase variability	Increased uncertainty for water users, drought declaration
Infrastructure	Developed Campgrounds	Increased peak flows	Increased risk for flood damage
Aquatics	Bull trout streams	Increase in summer water temperatures	Habitat fragmentation

WATER RESOURCE VALUES AT RISK

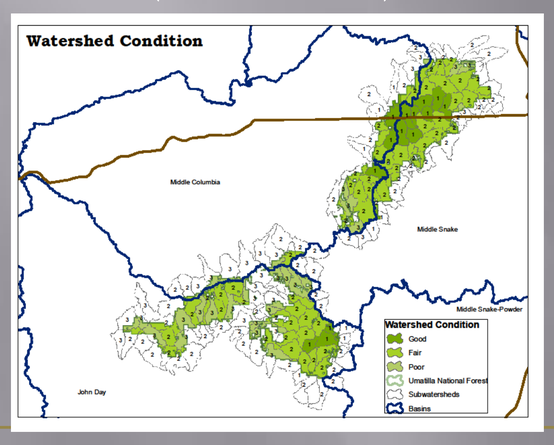
Water Uses : municipal and public supply watersheds, potable water systems, and on-Forest water rights.

Infrastructure: high value developments (campgrounds, admin. sites) and roads within riparian areas

Aquatics : # focal species (present occupied) and groundwater dependent ecosystems.

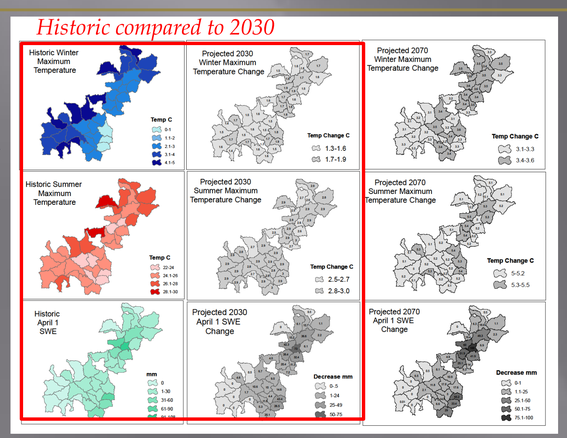
SENSITIVITY

Use base watershed condition model ratings, considers road density, forest and range condition, channel-aquatic habitat (Gecy, 2010). Modified by resilience factors (BUFFER) and threats (EXACERBATE).



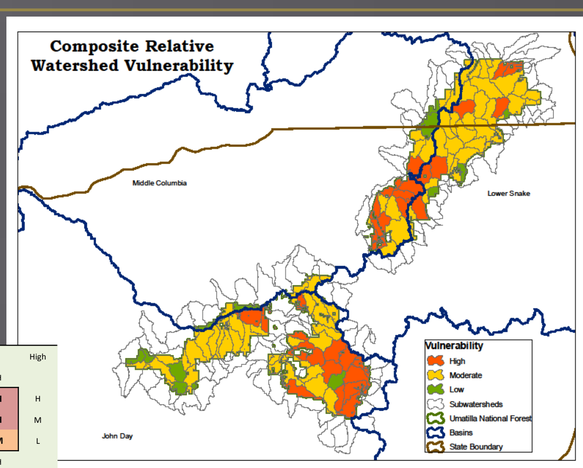
EXPOSURE

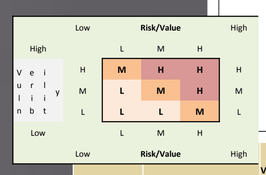
A growing body of published research in the PNW is showing regional trends in historic temperatures (warming), precipitation, snowpack and streamflows. (see for example Mote, 2003, Knowles et al, 2006, and Hamlet and Lettenmaier, 2007).



Downscaled climate and hydrologic models project future changes (CIG, 2010). Gridded data summarized by watershed (HU5) for 3 climate indicators: winter and summer temperature, April 1 Snow Water Equivalent (Apr1SWE). 2030 projections used in rating.
http://www.hydro.washington.edu/2860/report/

COMPOSITE WATERSHED VULNERABILITY RATINGS





HUC6	HUC_NAME	Values Rank	Sensitivity Rank	Values/ Sensitivity	Values/ Risk Rank	S_30_Cat	W_30_cat	SWE_30_Cat	Sum of Climate Data	Climate Risk Rate	Value/ Risk/ Climate	Relative Vulnerability	Simplified Vulnerability
170702040108	Alder Creek	40	4	44	H	2	2	1	5	M	H5	MH	M
170701040303	Balm Canyon	10	2	12	L	2	1	1	4	ML	L4	L	L
170701030106	Bear Creek	50	3	53	H	2	2	3	7	H	H7	H	H
170601060701	Bear Creek-Hunt Spring	30	2	32	ML	2	2	2	6	MH	ML6	M	M
170701030604	Bear Creek-West Birch Creek	30	2	32	ML	2	2	2	6	MH	ML6	M	M
170601060304	Beaver Creek N	20	1	21	L	2	2	3	7	H	L7	M	M
170702020203	Beaver Creek S	40	5	45	H	2	1	3	6	MH	H6	H	H
170702030204	Big Boulder Creek	20	3	23	ML	2	2	2	6	MH	ML6	M	M
170702020303	Big Creek N	40	5	45	H	2	2	2	6	MH	H6	H	H
170702030302	Big Creek S	20	5	25	MH	2	2	2	6	MH	MH6	H	H
170701020203	Blue Creek	20	1	21	L	1	2	2	5	M	L5	ML	L
170702040101	Bologna Canyon	30	1	31	ML	2	2	1	5	M	ML5	ML	L
170701030206	Boston Canyon	20	5	25	MH	2	2	2	6	MH	MH6	H	H

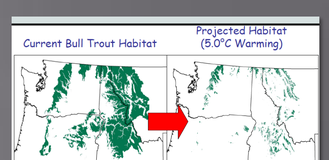
FINE-SCALE ANALYSIS -- BULL TROUT HABITAT

Background:

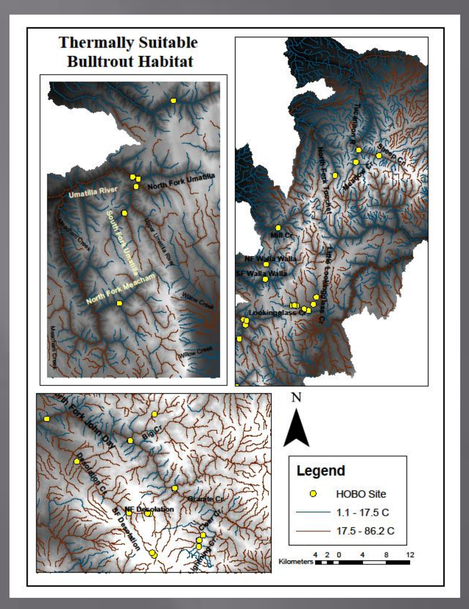
- Bulltrout ideal for analysis: listed under ESA (1997) requires managing agencies to monitor population trends.
- Specific to coldwater habitats (≤17.5 C) occur in remote high elevation areas-making monitoring logistics difficult.
- Bulltrout pop. on the Umatilla NF may experience greater losses; they are on the edge of the species' bioclimatic envelope (driest, hottest, low elevation) (Rieman et al, 2007).

Results:

- Current juvenile bulltrout distribution and spawning ground data were collected within 3 ESU units: John Day, Tucannon (Snake River and Washington recovery unit), and the Umatilla-Walla Walla recovery unit). 333 stream temperature observations used in model. Physical metrics used: Water diversion, Wildfire, Groundwater, Cumulative Drainage, Slope, Mean Elevation
- Regression analysis and ANOVA identify factors influencing stream temperature; coefficients used in regression for predictor model
- Suitable bulltrout habitat are designated by blue stream reaches (1.1-17.5 C)

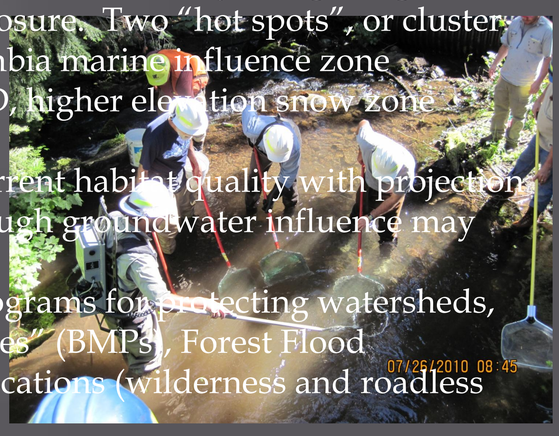


Rieman et al, 2007



FINDINGS AND FUTURE OPTIONS

- FOREST SCALE rating of relative watershed vulnerability to climate change shows majority of Forest "moderate" to "high" vulnerability using categorical indicators for Water Values, Sensitivity, Exposure. Two "hot spots", or cluster watersheds, show highest rating: mid Columbia marine influence zone (temperature vulnerability), and upper NFJD, higher elevation snow zone (water supply vulnerability).
- BULL TROUT habitat modeling shows current habitat quality with projection for some contraction and fragmentation, though groundwater influence may buffer climate impacts.
- INCREASE RESILIENCE Use existing programs for protecting watersheds, measures include "Best Management Practices" (BMPs), Forest Flood Emergency Response Plan (FERM), land allocations (wilderness and roadless areas as refugia)
- ACTIVELY RESTORE Evaluate restoration priorities and activities, address vulnerable infrastructure, passage barriers, riparian conditions.
- IMPROVE COORDINATION Forests are critical source of water and habitat, but resource availability and conditions are changing, more uncertainty. Consider findings in Forest planning, Regional vulnerability assessments and restoration strategies. Engage with communities in adaptation strategies.



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References: Hamlet, A.F. and D.P. Lettenmaeir, 2007. Effects of 20th century warming and climate variability on flood risk in the western US (WRR v. 43). Hurd et al, 1999. Relative regional vulnerability of water resources to climate change (JAWRA,v35, No6), Furniss, M.J. and 11 others, 2010. Water, climate change, and forests: watershed stewardship for a changing climate (PNW-GTR-812). Knowles, N, Dettinger, M., and D. Cayan, 2006. Trends in snowfall versus rainfall in the western US (J. of Climate). Mote, P.W. Trends in temperature and precipitation in the PNW during the 20th century (NW Science v77, No4). Rieman, B.E., D. Isaak, S. Adams, D. Horan, D. Nagel, and C. Luce. 2007. Anticipated Climate Warming Effects on Bull Trout Habitats and Populations Across the Interior Columbia River Basin. Trans. American Fisheries Society 136(6):

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